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ABSTRACT

The techniques used for teaching college economics have remained relatively unchanged over the past few decades. These techniques do not give the students an opportunity to apply, to develop, or to practice the economic theory they read about and hear in lectures. They tend to reinforce student assumptions about the subject's "givenness" and de-emphasize the discipline's dynamic nature. The recent revolution in micro technology and the availability of software have teachers of economics with an opportunity to let students in on the work of their profession, that is, "doing" economics. A computer laboratory provides students with a space within which to work closely with their professor or a graduate student. The increased availability of the instructor and the increased interaction with the material can help students learn more and learn more effectively. Even at the undergraduate level science can be exciting when both anticipated and unanticipated results arise during the experimentation process. Since undergraduate would-be economists rarely experiment, the thrill that comes with discovery is missing. Only by adopting a lecture/laboratory format can theoretical knowledge and experimental discovery be brought together to enhance student learning. This type of approach is being tried at Denison University (Ohio). A 51-item bibliography is included. (JB)

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Teaching Economics as a Laboratory Science

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Teaching Economics as a Laboratory Science

The purpose of this paper is to argue that teaching economics as a laboratory science can be more effective in helping students "to think like economists" than the standard formats for teaching economics. The latter are not consistent with science teaching and do not take advantage of available technology. The paper describes the beginnings of an experiment at Denison University in which the current curriculum is being transformed by reorganizing it and adding weekly laboratory exercises to traditional economics courses. Additional resources are not required when existing courses, credits, and staff are effectively reallocated.

Introduction. Curriculum change can focus on content, pedagogy, or both. Thus, changing a curriculum is a massive undertaking. Making that effort, even with extensive faculty development funding, implies either that the existing curriculum is failing on one or both of the accounts mentioned above, or that the proposed new curriculum shows sufficient promise on one of these accounts to warrant its implementation. Siegfried and Wilkinson [1982] show that the current content of economics seems to be generally agreed upon by most economists. Students take an introductory course in economics followed by intermediate theory courses in micro- and macroeconomics. Then students enroll in courses which focus on one or two of the many advanced fields of study in economics. The economics major generally concludes with an advanced seminar on a particular subject or a capstone course intended to tie together previous learning.

Dissatisfaction with the current content and pedagogy of the economics curriculum begins when instructors design courses and have to decide how to divide class time between theory and applications. With more time spent on theory, more "material" is "covered," but it is not clear how well students actually understand the material. With more time spent on applications, the students understand the material better, but less material is covered. Furthermore, while there is some consensus about the content of

the undergraduate economics major, that content is continuing to expand with little previous material being deleted [The Journal of Economic Education, 1987]. As a result, choices about coverage are becoming harder to make.

How Economics is Taught. Undergraduate economics classes are typically taught in three broadly different formats. Principles and intermediate theory courses are sometimes taught in large lecture halls with 100 - 1000 students in attendance. The instructor is a performer (often televised) with a focus on lecturing or presenting basic economic concepts in a noninteractive way. Weekly question and answer sessions with a teaching assistant are the typical pattern of student/faculty interaction and provide students with an opportunity to work through problem sets. Substantive feedback comes only after each of a series of objective hour exams.

In a second format, classes are much smaller (25-40 students) and have more of an emphasis on student/faculty interaction. The format tends to be "lecture/ discussion" with the instructor lecturing and spontaneously entertaining questions from students. The increased student/faculty interaction in class helps students learn the material. Workbooks, problem sets, and simulations are sometimes used as complementary teaching techniques giving students an opportunity to use theory to solve contrived or simple economic problems. Besides instructor responses to student inquiries, hourly exams and term papers provide students with feedback on how well they "think like economists."

A third approach, used only in advanced senior seminars with relatively few students or at small liberal colleges, combines the lecture/discussion format with more direct and meaningful student/faculty interactions. Students are required to engage in an in-depth study of a carefully chosen research project or position paper. A significant portion of the students' grades are determined by their oral presentations to the class and/or their final written papers.

It is only in this last format that instructors of economics expect their students to be more than mere receptors of economic knowledge and manipulators of contrived exercises. Nonetheless, we expect students to eventually learn "to think like economists" without providing them with any real opportunity to learn how economists go about "doing" economics.

Lee Hansen [1986] recently observed in an article in the American Economic Review:

> ...about all ... economics faculty can claim for our majors is their ability to answer our examination questions with some facility. Implicit in our approach is the assumption that exposure to a range of courses produces learning, learning that enables students ... to apply their knowledge to a variety of questions and issues they will confront as citizens ... Whether graduating economics majors can in fact apply their knowledge as citizens or employees is not clear, to us and perhaps to them either. [p. 149.]

If students are not learning to "think like economists," then our current pedagogy is failing to do what we intended. While no one has really tried to test whether our students think like economists, there has been some disappointment with how well our students do on more traditional measures of performance.[1] The reasons for these disappointments are many and may apply only to particular experiments; however, there is reason to suspect that economic education is less than it could be for two reasons. There is a general lack of understanding among instructors of economics about how students learn,[2] and there is a reluctance to teach economics as a science.

Bloom [1971] describes the general learning process for students as a sequential process. His taxonomy of educational objectives suggests that students begin learning at a very rudimentary level of understanding, such as basic facts and definitions. In an effective learning environment, students then progress to understanding simple functional or causal relationships. A good example of these two steps in economics is that students need to know the precise definitions of income and Gross National Product in order to understand the National Income Accounts. Students then build

upon their knowledge of facts, definitions, and simple relationships to develop more sophisticated understandings of complex interrelationships and systems of equations. Building an aggregate model of economic behavior does little good unless students fully understand each of the underlying relationships of the model. Eventually, students will be able use underlying assumptions and an understanding of complex systems to evaluate the relative merits of alternative policy choices. A student who understands why increasing the money supply is inflationary to a monetarist and expansionary to a Keynesian and when it makes sense to take each view, has a sophisticated understanding of basic macroeconomic theory. But macroeconomic courses are rarely designed with Bloom's taxonomy in mind even though it makes perfect educational sense. Instead, most instructors of macroeconomics try to reach the highest level of Bloom's educational objectives without guiding students through the prerequisite stages of basic economic understanding.[3]

The second reason for the failure of economic education to achieve its objectives is that while economists define their subject as a science concerned with allocating scarce resources to meet society's wants and needs, they do not teach economics as if it were a science. All of the contemporary approaches to teaching economics described above are in sharp contrast to the pedagogy of the physical and life sciences. Beginning in high school and continuing on through undergraduate years, nascent scientists learn both "about" and "how to do" science; that is, they learn some of what scientists know and how scientists go about knowing. The latter is accomplished by giving students "hands-on" experiences in the laboratory or in the field. Indeed, both scientists and educational psychologists contend that learning can not take place in any other way. Jill Larkin [1981], a Carnegie-Mellon psychologist argues:

> I have never known anyone skillful in physics (or use of any other formal body of knowledge) who claimed to have acquired this skill solely through extensive study of textbooks, or even through extensive

> observation of skilled individuals. Virtually unanimously, individuals report acquiring skill through practice. ... [E]ven a diligent student, who has learned all the principles that were presented, when faced with his [sic] first problem has no meaningful way of deciding which of these principles would be most useful to apply. Perhaps it is not surprising, then, that students so often complain that although they study the text they are largely unable to solve problems [pp. 534-35].

Indeed, very few of us learned "to think like economists" from classroom presentations. We learned the received doctrine; that is, what economists claim to know, but we did not learn how economists go about the task of knowing. Instead, we spent much of our time as undergraduates and as graduate students regurgitating lectures on true/false or multiple choice exams, solving countless problem sets, or writing term papers. Most of us acquired our theoretical and empirical skills when we began to engage in our own research projects which required us to use the theory we had learned in the classroom and to experiment with the empirical tools we had learned in econometrics. The physics profession understands this connection between learning and doing, "[s]tudents cannot learn to understand the relationship between physics theory and experimental evidence if they have minimal personal experience in designing and performing experiments" [American Association of Physics Teachers, 1987].

The worth of the laboratory as a teaching device is well established. Holdzkom and Lutz [1987] contend that science education at all levels must be experimental in nature if it is to be effective, "[t]he assumption is that the techniques needed for effective science teaching are the same as those used for effective science investigation. Put another way, it says that the methods for learning science should be the same as the methods for doing science" [p. 161].

The same argument can be made for students learning economics: they cannot learn economic theory and empirical analysis without personal experience in designing and performing economic research. If we want our students eventually "to

think like economists," we need to design a curriculum which gives them continuing oportunities for "hands-on" experience, direction, and support over the course of their studies and not just at the end or a few points during their academic careers.

Teaching economics as a science means we need to develop laboratory components for our courses. Laboratory exercises can take a variety of forms including spending additional class time running computer simulations, doing statistical analysis, and actually performing experiments.[4] The purpose of these exercises is to give students the opportunity to have a personal "hands on" experience as do students in the natural and life sciences.

Moreover, a laboratory component can provide an arena where students can be guided through each of Bloom's educational stages [Holdzkom and Lutz, 1987, pp. 52-53]. Beginning labs can be devoted to making sure students understand basic definitions. The next sequence of exercises could help students discover the laws of supply and demand by having them manipulate price and cost functions on a spreadsheet and simultaneously graph the changes. Eventually, students will be able to build and use their own models.

Technological Developments and Teaching Economics. The teaching of economics has not kept pace with technological developments in the micro- and personal computer industry. The dramatic expansion of the world of personal computers, both in terms of the capabilities of the hardware and the availability of software, has made the electronic classroom a reality.[5] Computer laboratories provide students with the opportunity to explore the complexity of the real world in sophisticated ways. For example, students in a Money and Banking course may engage in a role-playing simulation of the Federal Reserve's Open Market Committee. Some students may act as Federal Reserve Governors and others may serve as staff responsible for gathering and analyzing the data necessary to understand current economic trends and make

monetary policy decisions. A computer laboratory greatly enhances this simulation by allowing students to use existing macroeconomic models of the U.S. economy to simulate the effects of different proposed policy options on aggregate economic variables such as income, employment, interest rates, and the price level.

While the cost of acquiring hardware for computer laboratories has been reasonable for some time, the cost of acquiring macroeconomic models has been beyond the reach of most educational institutions. Until very recently, such models were too expensive for all but large firms and government agencies. Now, several of the major macro models of the economy are being offered to academic users at reasonable prices. The FAIRMODEL produced by Economica and the DRI forecasting model produced by Data Resources, Inc. are two examples of macroeconomic models widely used by industry that have been adapted and made available for classroom use on personal computers. In addition, there has been rapid development of academic software by the authors and publishers of economics textbooks. David Friedman's [1987] indifference and cost curve models are excellent examples of the latter, as are the Macrosolve models which accompany Robert Hall and John Taylor's Macroeconomics text [1988].

Access to materials like these greatly enhances students' abilities to understand, develop, and apply economic theory. The present confluence of rapidly declining prices for personal computers and of accelerating development of appropriate commercial software packages makes this an especially propitious time to integrate several computer laboratory components with the economics curriculum.

Most importantly, the laboratory facility allows students to conduct experiments, analyze data, and manipulate economic models with regular supervision by faculty members. Such on-site supervision is important in order to provide students with immediate feedback on their exercises. Students in the physical/life sciences are used to this kind of close student/faculty interaction. When a student discovers a

phenomenon she/he cannot explain in a chemistry laboratory, the faculty member is there to assist and give direction. Until now, that same student, working on the analysis of an econometric problem at a terminal in one of the mainframe terminal rooms probably has not found the instructor immediately available. Therefore, if a student begins to have problems with the computer or gets inexplicable results, no one is there to help. Students must leave their work station to locate the instructor or wait until the next class period to ask a question. Doing this kind of teaching without a laboratory is an inconvenient and inefficient way for students to learn and for instructors to teach. To facilitate faculty/student interaction, instructors can and do bring a computer terminal into a classroom for demonstrations. But, 25 students huddled around one terminal is still not a very effective way of teaching. A dedicated personal computer laboratory can provide economics students with the same pattern of feedback and analytical support experienced by students in the physical/life sciences. In addition, students are free to proceed through lab experiments or demonstrations at their own pace, a real advantage for classes with differential abilities.

A lecture/laboratory format mirrors the expanding theoretical and empirical content of the discipline and makes the connection between theory and practice more direct. At the same time, it reduces the necessity to trade off between theory and applications. Economics instruction becomes more lively as students gather their own data or use existing data bases to contribute to their own learning. Students confront real problems, make decisions, and suggest policy actions in the laboratory. Appropriate data is no longer merely discussed because students are themselves actively utilizing the data and engaged in the discovery of fundamental economic relationships.

In general, we believe that the current teaching practices in economics do not reflect how economists "do economics." Economists formulate hypotheses, examine evidence (typically quantitative data) to test their hypotheses, and then restructure their

arguments to more closely capture the nuances of the real world. It is this methodological cycle of generating hypotheses and testing them which is at the heart of what economists and scientists do -- it is our version of the scientific method. Economists need to rethink and reorganize their courses in order to bring the pedagogy of undergraduate economics courses into line with the practices of the discipline. Like the physical/life sciences, economists need to place major pedagogic emphasis on learning by doing. As in science classes, lectures should provide general information, while laboratory experiences reinforce student understanding of concepts by allowing them to discover, expand, and apply theory themselves. We have borrowed this pedagogic style and are beginning to teach economics as a laboratory science.[6]

The Organization of the Economics Curriculum. The economics curriculum in place in 1987-88 at Denison University offered the traditional mix of courses found in undergraduate economics departments across the country. Our majors took at least seven courses, each carrying four hours of credit: principles of economics, intermediate macroeconomics, intermediate microeconomics, econometrics, two advanced applied courses, and a senior seminar. In the last course, the senior seminar, students were expected to apply economic theory and to use the empirical tools learned in econometrics for an in-depth study of a particular topic of mutual faculty/student interest.

Delaying this "hands-on" experience until the end of a student's career was problematic for several reasons. First, to be most effective, the "hands-on" activity should have accompanied the theoretical material it was intended to reinforce. Second, the old sequence of courses encouraged students to compartmentalize knowledge and to dissuade them from drawing connections between and among courses. In student minds, each course was often treated as a discrete entity seemingly unrelated to its predecessors or antecedents. For example, students in intermediate microeconomics

had often forgotten the simple models of supply and demand learned in principles. Similarly, students in labor economics failed to draw connections between resource markets and commodity markets. Or, they forgot that the empirical findings quoted in labor studies were derived from simple statistical techniques developed in econometrics. Often, the senior seminar was one more in a series of such discrete courses.

A third problem was that econometrics, the basic empirical methodology course in most programs, was separated from the senior seminar by several terms. Without constant use and reinforcement of empirical tools, the ability to apply analytical skills to research questions was quickly lost. Students in senior seminars found that they had to relearn some theoretical and empirical material to do economics. Finally, the attention of second semester seniors was often diverted by their post-baccalaureate plans.

Previous attempts to bridge the gap between theory and practice have been made, employing a variety of teaching techniques. Courses designed to allow students to "do what economists do" have been created elsewhere, but they have usually been ad hoc efforts designed by and for a particular faculty member to use in a specific course [Millerd and Robertson, 1987; Smith and Smith, 1988]. Some instructors have used classroom simulations to create a life-like situation within which to apply theory [Bartlett and Amsler, 1979; Day, 1987; McGrath and Tiemann, 1985]. At Denison University, we have been developing and using simulations in our courses since the mid 1970s. In managerial economics, students explore several case studies with computerized simulations allowing them to experiment with alternative decisions. In money and banking students role-play as members of the Federal Open Market Committee. In urban economics students test their understanding of a city's infrastructure by simulating various growth strategies with Milderson, an economic

computer simulation of an urban area. The effectiveness of many of these efforts has been evaluated and reported in the economics education literature [Bartlett and Miller, 1981; Fletcher and Karian, 1976, 1979; Harms and Huff, 1981, 1987; King, 1979; Miller and Henderson, 1983]. Despite these developments, no department has tried to integrate such approaches across the curriculum in order to develop and reinforce student ability to use economic theory and methodology.

Transforming the Economics Curriculum. The prevailing pedagogy, classroom structure, and course content and organization creates and then reinforces the gap between theory and practice in economics. As we envisioned the lecture/laboratory curriculum, students would begin learning economics in a traditional principles of economics course with weekly laboratory exercises. The lecture/ laboratory format for teaching economics then continues through other core courses in intermediate theory and econometrics, and in several advanced courses. Since the computer has become the principal research tool for economists, laboratory exercises typically, but not exclusively, are designed around the use of personal computers. The skills, both theoretical and empirical, acquired in one course are used in used in the next course and can be more easily transferred through the common laboratory experience.

Using a computer laboratory to teach economics applications is not to be confused with traditional computer assisted instruction efforts. The purpose of the laboratory is not to have students answer workbook questions or problem sets on a computer, but to use the computer as a tool for collecting, manipulating, and analyzing their own data. While the evidence supporting computer assisted instruction has not been very strong [Siegfried and Fels, 1979], preliminary evidence suggests that economic laboratories engage students more actively in the learning process and in the discovery of economic principles [Bartlett and King, 1988]. Students are able to learn not only what economists know on matters of supply and demand, but also how economists go about

discovering these principles. Students will have attained a certain level of sophistication by the time they graduate. More importantly, they will have learned how economists learn and how to use those same skills to learn more effectively themselves.

An Example of the New Curriculum. For these reasons, we are in the process of reorganizing our curriculum. Our new model requires students to take the four core courses, three of which (intermediate micro, intermediate macro, and econometrics) have accompanying laboratories. At present, College-wide enrollment patterns will not allow us to impose small enough enrollment limits on principles to utilize the lab format there. To complete the major, students must take three additional advanced courses, at least one of which must have a laboratory component. The new economics major requirements, therefore, include a total of seven economics courses which is equal to the previous requirement. The principles course carries four hours of credit and the four lecture/laboratory courses will each carry one additional credit hour for a total of five semester hours of credit each. The other advanced courses may be four-credit non-laboratory courses or five-credit lecture/laboratory courses. In order not to add extra credit hours we have dropped a statistics requirement. We have significantly reduced our senior seminar offerings, the intent of that course being fulfilled by the laboratory components of the core courses. We will still offer some seminars to provide advanced study for our very best students and to provide the oportunity to teach occasional specialized courses of particular interest for our faculty. Table 1 details the curriculum changes.

The econometrics course will become a more important part of the core; it will fit earlier into the sequence as an introduction to econometric methodology. Students will find that the research tools developed in this course will be utilized repeatedly in others. They may also find that they use the same data bases in different courses; or, they may create their own data base and discover that it can be utilized for more than one

research project in different courses.

Table 1

Minimum Course Requirements and Credit Hours

Lecture versus Lecture/Laboratory Economics Curricula

Lecture Format		Lecture/Lab Format		Description
Math 102	4			Statistics
Econ 200	4	Econ 200	4	Principles
Econ 301	4	Econ 301-A	4	Intermediate Macro
		Econ 301-B	1	Intermediate Macro Lab
Econ 302	4	Econ 302-A	4	Intermediate Micro
		Econ 302-B	1	Intermediate Micro Lab
Econ 331	4	Econ 307-A	4	Econometrics
		Econ 307-B	1	Econometrics Lab
Econ 310-323	8	Econ 310-350 - A	12	Advanced Courses
		Econ 3 - - B	1	Advanced Lab
Econ 350	4			Senior Seminar
Total Credits	**32**		**32**	

The new program is being phased in over the 1988-90 academic years. Each of the ten faculty members in the department is designing a laboratory course to be attached to one of the traditional courses. During each of the summers of 1988 and 1989, four staff members are working with the project and evaluation directors. Together they

comprise a curriculum development team engaged both in developing their own laboratories and testing and evaluating the developments of others. Faculty members receive one course released time during the year in which they introduce their laboratory course. Summer development, released time, and software acquisition are being financed by a grant from the Fund for the Improvement of Post-Secondary Education.

Patterned after the physical/life sciences, our laboratory courses have become an integral part of the learning process for our economics students. Laboratory courses were developed for intermediate micro, intermediate macro, econometrics, industrial organization, third world development, and labor during Summer, 1988. The first laboratory courses were taught during the 1988-89 academic year. In Summer, 1989, we will add money and banking, international trade, international finance, and managerial. The laboratory components include a wide variety of learning opportunities. Most exercises are done in one physical location -- a personal computer workroom -- dedicated to economics students and equipped with 13 Macintosh SE computers with one megabyte RAM and 20 megabyte hard drives. We also have a Macnifier that provides an overhead projection of the image on the instructor's screen. The computers are networked and the room includes printing facilities. The network is connected to the College's VAX mainframe. The hardware in the laboratory was financed with an NSF-CSIP grant.

Transferability of the Lecture/Lab curriculum. The traditional formats for teaching economics can be effectively transformed to one that more actively involves students in the learning process. Large lecture halls can still be used to deliver theoretical information. Graduate students assigned to traditional discussion sections can now work more closely with students by running laboratories which stress applications. More and more publishers are coming out with these kinds of exercises to accompany

texts. That should help ease the process of transition to a new pedagogy.

Medium size classes could incorporate laboratory sections with fewer administrative problems. For those just beginning a lab format, the laboratory time could be initially used to discuss journal articles, current economic events found in the Wall Street Journal or other news sources, or student research projects. The notion of a laboratory experience and what it is should be interpreted very broadly to include a variety of supplemental teaching techniques in addition to microcomputer laboratory exercises.[7] Acquiring a computer lab is an expensive step. While many universities and colleges have rooms filled with personal computers and terminals devoted to such purposes, even a regular classroom can serve as an interim location.

Finally, many universities make a distinction between the teaching loads of natural and life scientists and those of the social scientists. Economists teaching economics as a laboratory science should teach fewer course sections in order to offset the additional preparation and teaching time needed for laboratory exercises. That is, an economist and a physicist each teaching lecture/ laboratory courses should get the same teaching load credit.

Summary. The techniques used for teaching economics have remained relatively unchanged over the last few decades. The amount of material to be covered in the classroom has grown exponentially while the amount of time devoted to classroom instruction has remained the same, making it increasingly difficult to decide how to spend class time. Just as economic theory would suggest, the tradeoff for spending more time on theoretical material is becoming increasingly costly in terms of student understanding and interest in the subject. The rush to cover material leaves students without an opportunity to acquire the necessary personal experience within which to ground the material. Economics as it is currently taught lacks the vital "hands-on" experience that students of other sciences receive.

For us, and for the profession at large, there are two reasons why the option of teaching economics as a laboratory science did not exist as a viable alternative to the lecture format until very recently. First, an integrative rationale built on sound educational objectives for incorporating a new pedagogy across the economics curriculum did not exist. Second, there were no low cost personal computers or user friendly software available for classroom use. An integrative pedagogical rationale can be drawn from the other sciences. The nontrivial costs for the computer hardware, software, and faculty development are justified and manageable based upon this rationale.

The three pedagogical formats for courses that we mentioned above do not give students an opportunity to apply, to develop, or to practice the economic theory they read about and hear in lectures. The existing teaching formats for economics tend to reinforce student assumptions about the subject's "given-ness," and de-emphasize the dynamic nature of the discipline. The recent revolution in microcomputer technology and the availability of software have provided teachers of economics with an opportunity to let students in on the work of their profession, that is, "doing" economics. A computer laboratory provides students with a space within which to work closely with their professor or a graduate student. The increased availability of the instructor and the increased interaction with the material can help students learn more and learn more effectively. Even at the undergraduate level science can be exciting when both "anticipated" and "unanticipated" results arise during the experimentation process. Since undergraduate would-be economists rarely experiment, the thrill that comes with discovery is missing. Only by adopting a lecture/laboratory format can theoretical knowledge and experimental discovery be brought together to enhance student learning.

Endnotes

[1] See Siegfried and Fels [1979] for a survey of pre-1980 work in economic education. Many of the problems confronting economic educators then still exist today despite advances in learning theory and empirical methodology. Also see Lumsden and Scott [1987]; Siegfried and Raymond [1984, 1985]; and Walstad [1984].

[2] There is one noticeable exception to this statement and that is the Resource Manual for Teacher Training in Economics [1978] edited by Saunders, Welsh, and Hansen. The authors do an excellent job developing teaching goals and techniques based upon sound learning theory. A more recent attempt has been made by Charkins, O'Toole and Wetzel [1985].

[3] See Bartlett and Amsler [1979] and Bartlett and Miller [1981] for examples of designing, implementing, and evaluating a course based upon Bloom's taxonomy.

[4] For some examples of potential laboratory experiments and activities, see Beckman [1987]; Case and Fair [1985]; Day [1987]; Leuthold [1987]; Lovell [1987]; McGrath and Tiemann [1985]; McNown and Hunt [1984]; Miller [1983]; Millerd and Robertson [1987]; Pulley and Dolbear [1984]; Scheraga [1986]; Walker [1987]; and Yohe [1986].

[5] Some examples of experiments with electronic classrooms in economics can be found in Beckman [1987]; Friedman [1986]; Post [1985]; Rycroft [1987]; Smith and Smith [1988]; Walstad, Hallows, and Ross [1986]; Yohe, Schenk, and Walstad [1987]; and in the Winter, 1986 edition of the Social Science Microcomputer Review, which includes a "Symposium on Microcomputers in Economic Education," edited by William P. Yohe.

[6] Our own convictions about teaching economics as a laboratory science have been developed and reinforced by our experiences with simulations and by the opportunity several of us have had to teach "Scientific Inquiry and the Human Prospect," a general education requirement for first year students at Denison University. This

lecture/laboratory course is team taught by a social scientist and a physical/life scientist. One purpose of the course is to demonstrate the similarities in methodology that exist between the social and natural sciences. Members of the economics department have taught with chemists, physicists, astronomers, and biologists. Participation in the development and implementation of laboratories for these very specialized courses demonstrated to us the pedagogical advantages of the laboratory component and its potential benefits and feasibility in the teaching of economics.

[7] See Bogan [1984]; Crowe and Youga [1986]; Fels [1984]; Field, Wachter, and Catanese [1985]; Hansen [1983]; Rhodes and Gervey [1984]; and Spencer and Van Eynde [1986].

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